(12) UK Patent Application (19) GB (11) 2 107 671 A

(21) Application No **8117413**
(22) Date of filing **8 Jun 1981**
(43) Application published **5 May 1983**
(51) **INT CL**[3] **B60P 1/44**
(52) Domestic classification **B8E** 22B1 **B8L** 27 CB
(56) Documents cited **None**
(58) Field of search **B8E**
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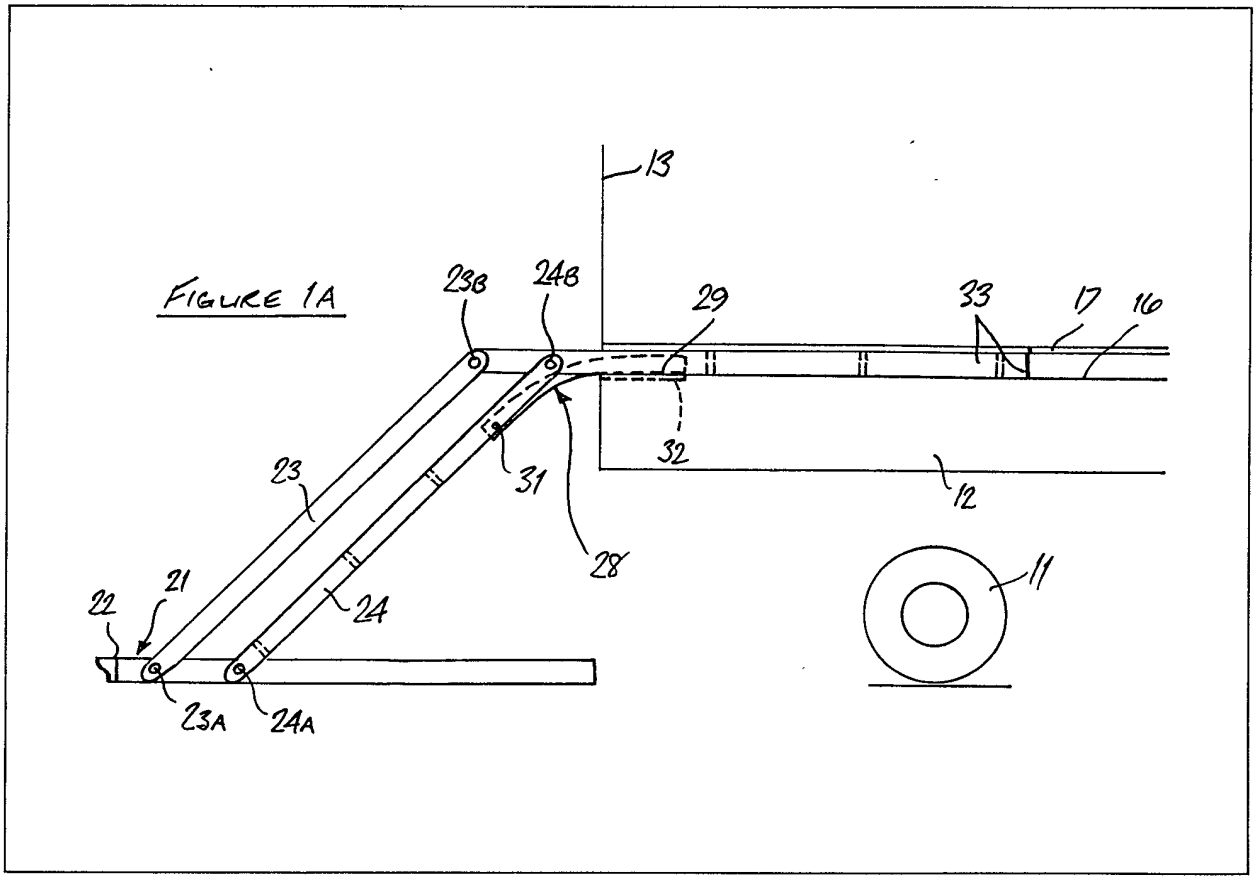
(54) **Platform lift**

(57) A load lifting and lowering platform 21 is pivotally suspended on the adjacent ends of the arms 23, 24, of a deformable parallellogram linkage. The other ends of the linkage arms are pivotted to a travelling chassis which, in use, moves back and forth out of and into a vehicle body serviced by the platform. One of the arms of the linkage engages a curved surface 28, and is forced to follow the curvature of that surface to automatically unfold or fold the linkage and thereby lower or raise the platform. The curved surface may be a rigid surface which can be swung up out of the way when the platform is stowed, or it may be a flexible bar as shown which can deform into a rigid curve to unfold the linkage and then progressively straighten again to fold the linkage.

Preferably the deformable bar travels with the chassis into and out of the vehicle body, and in one particular embodiment the platform, bar, linkage and travelling chassis all slide forward into a box which is fitted into the vehicle floor and is removable as a self-contained lifting unit.



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

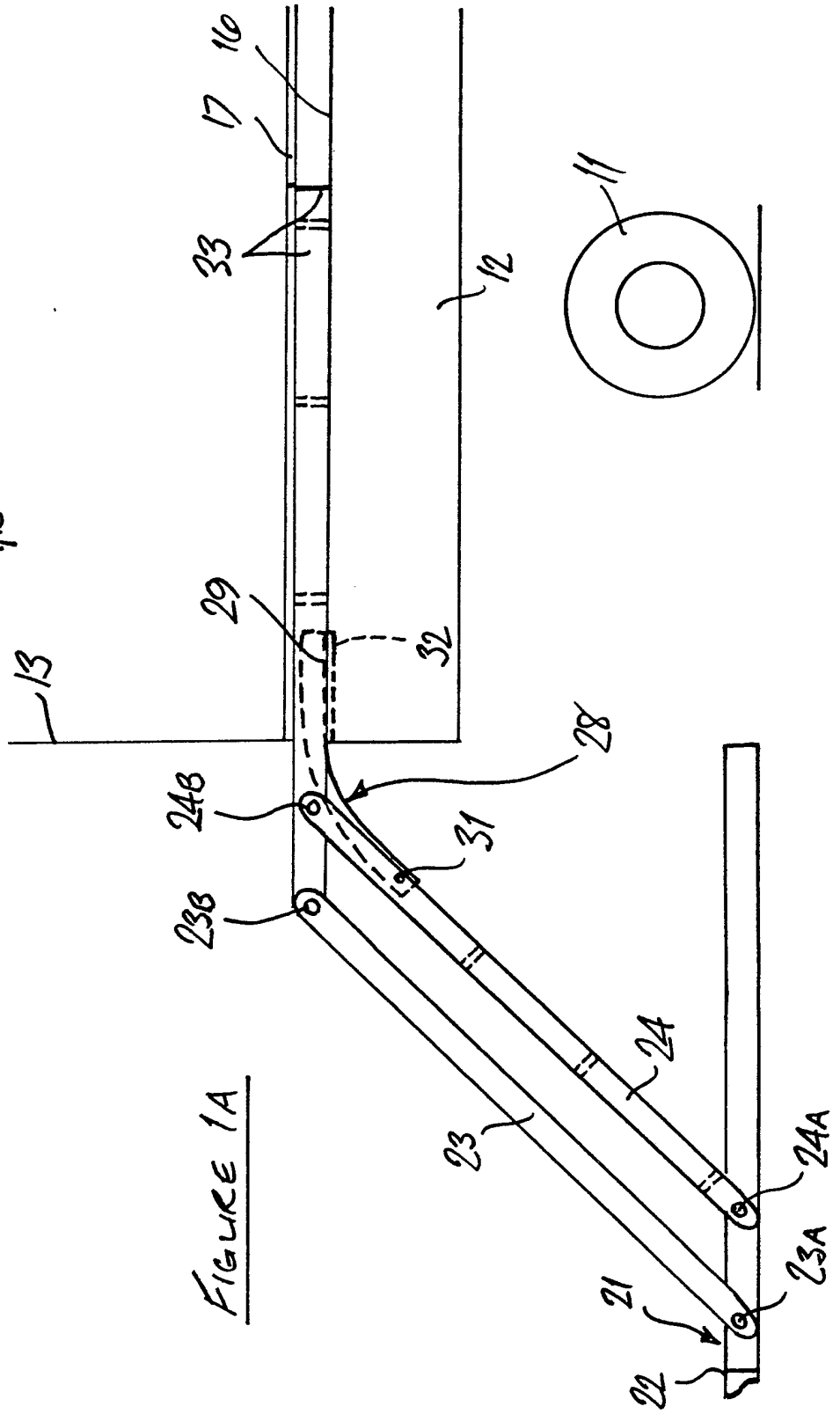


FIGURE 1A

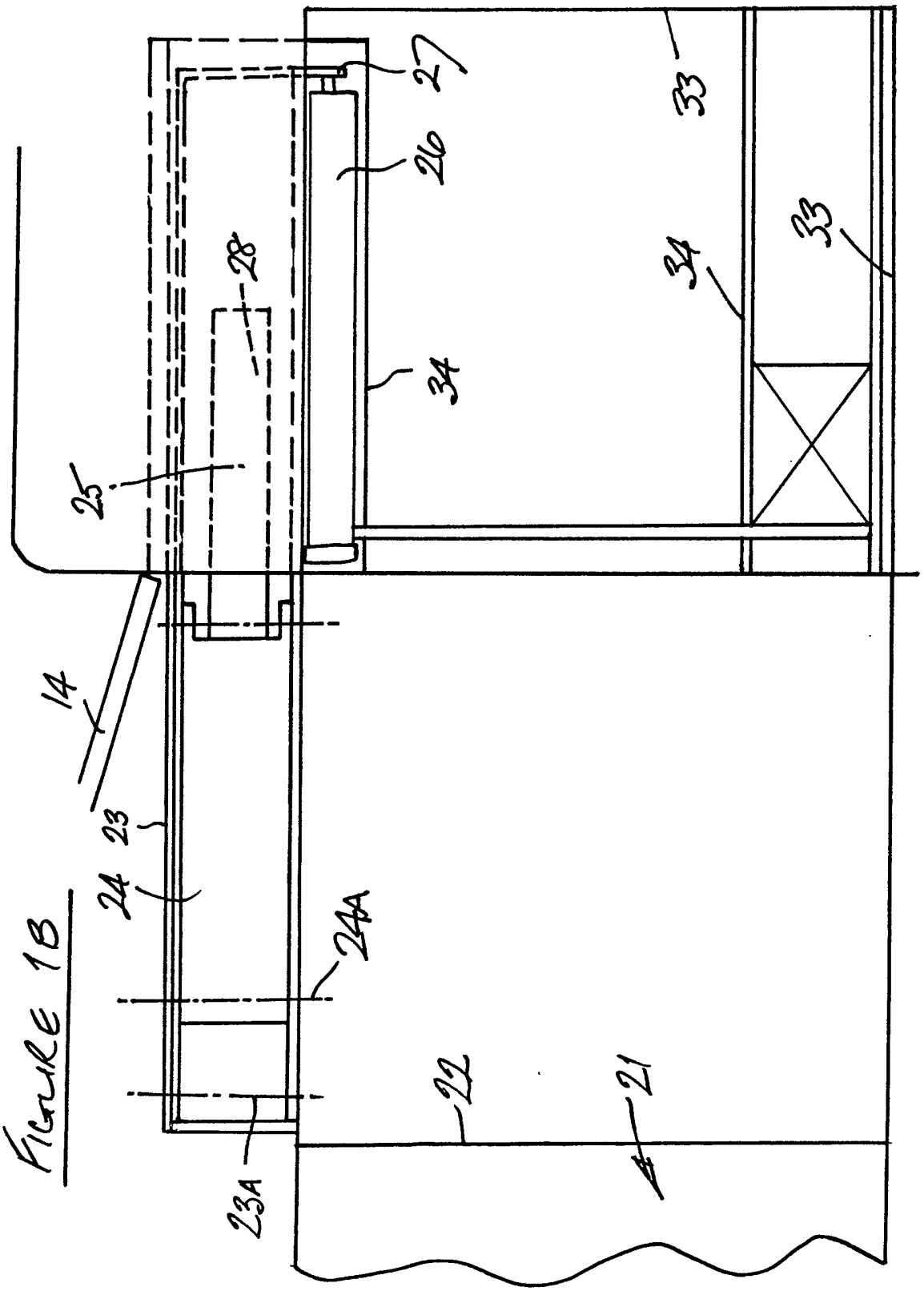


FIGURE 1B

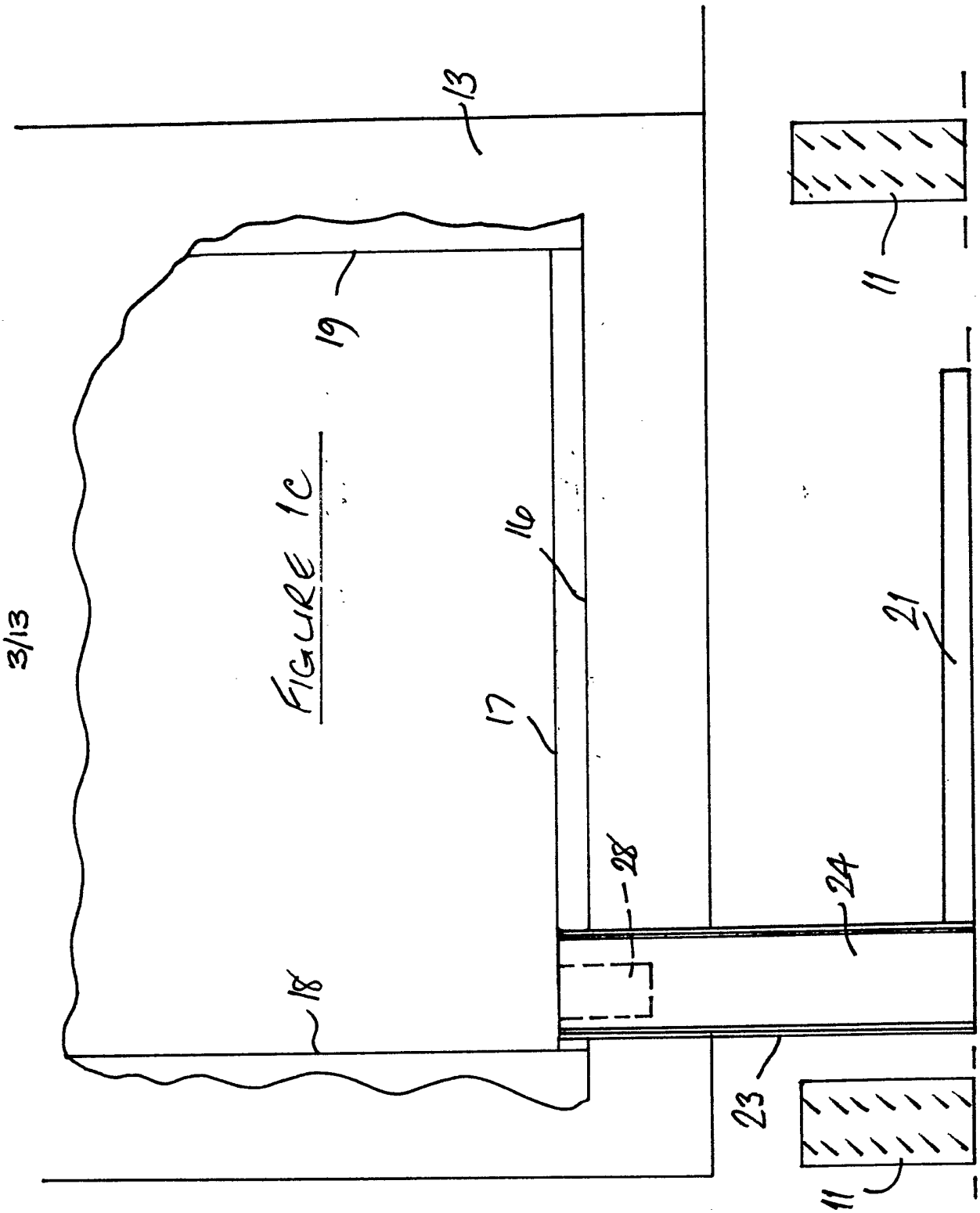
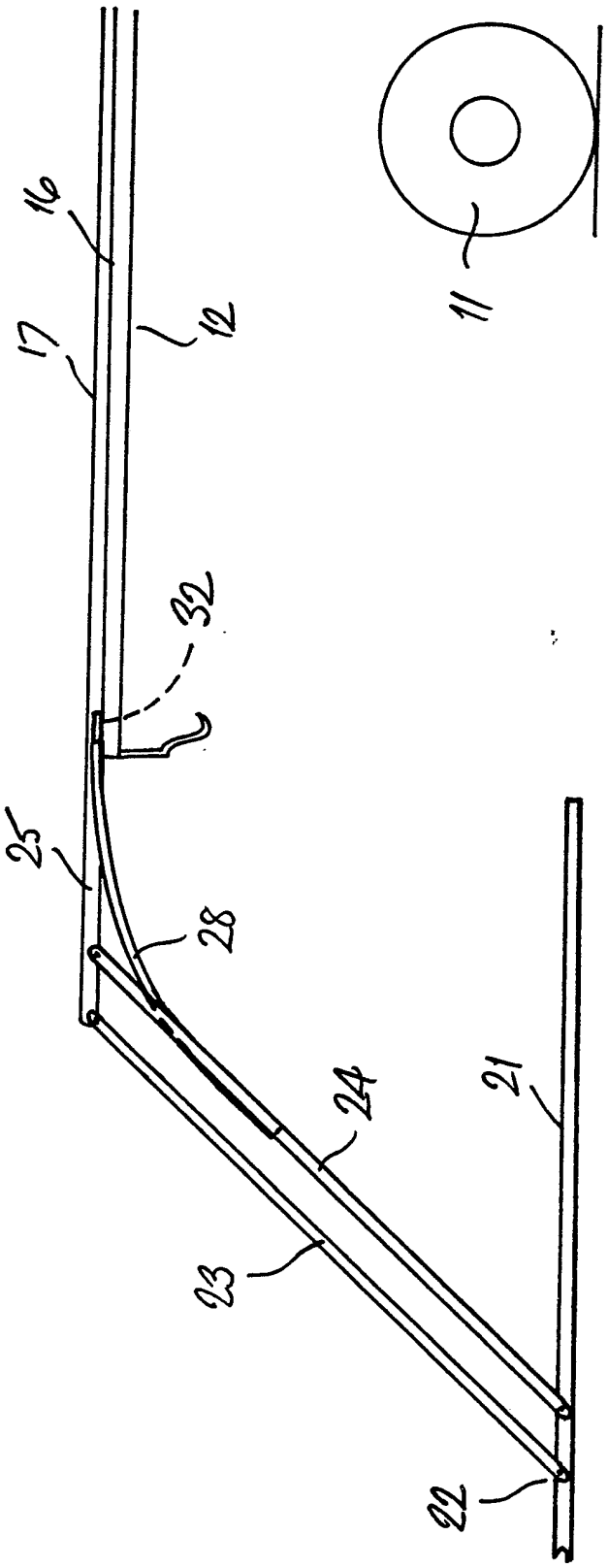


FIGURE 1C

FIGURE 2A



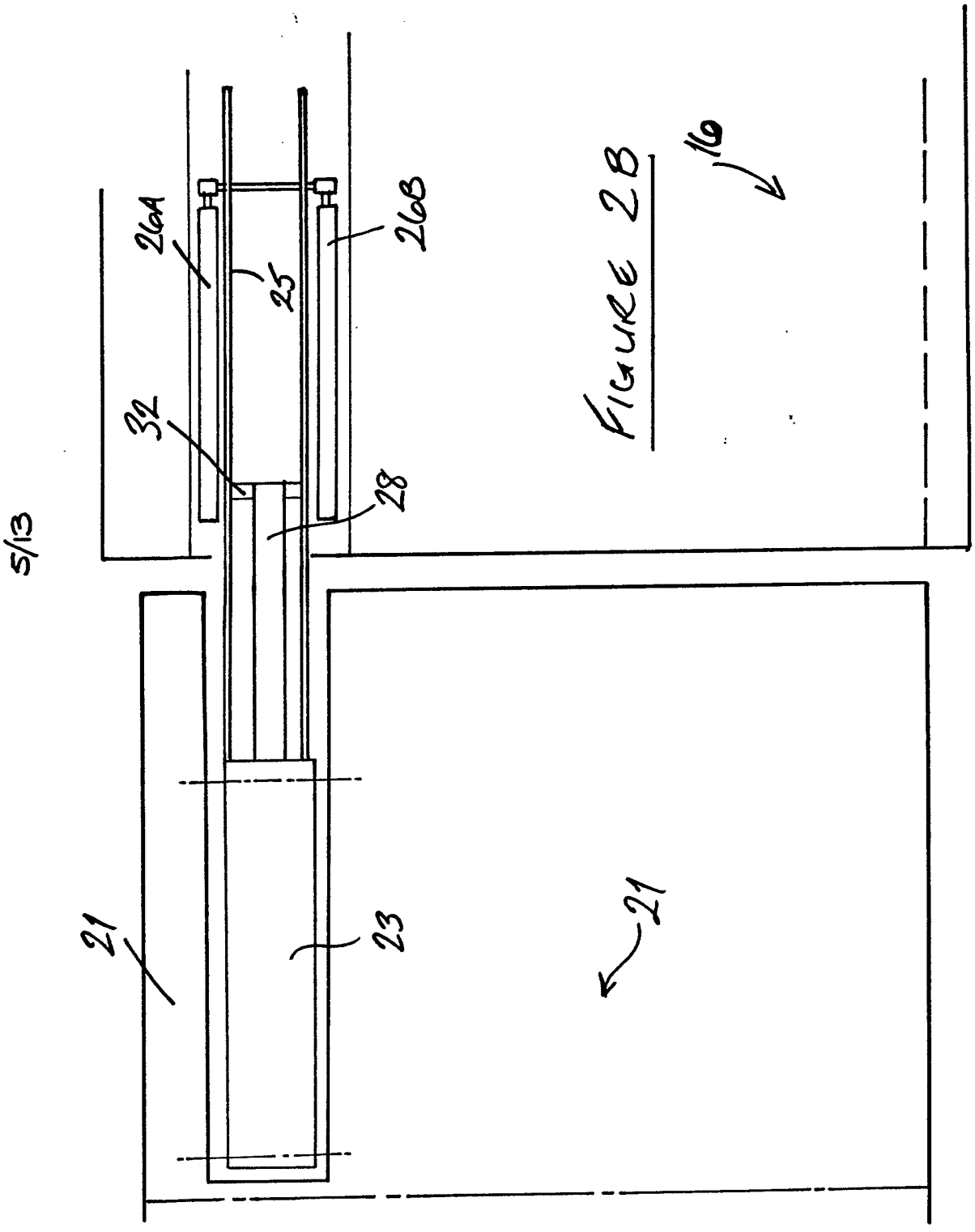


FIGURE 2B

FIGURE 3A

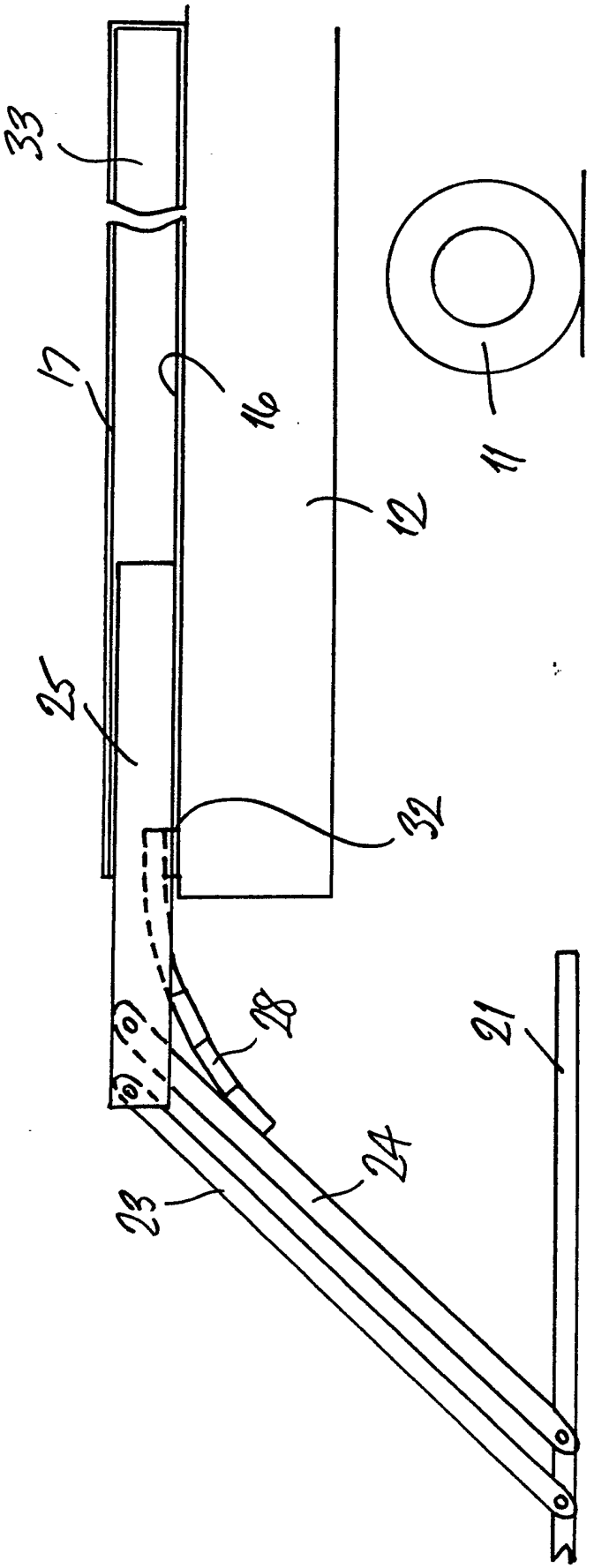
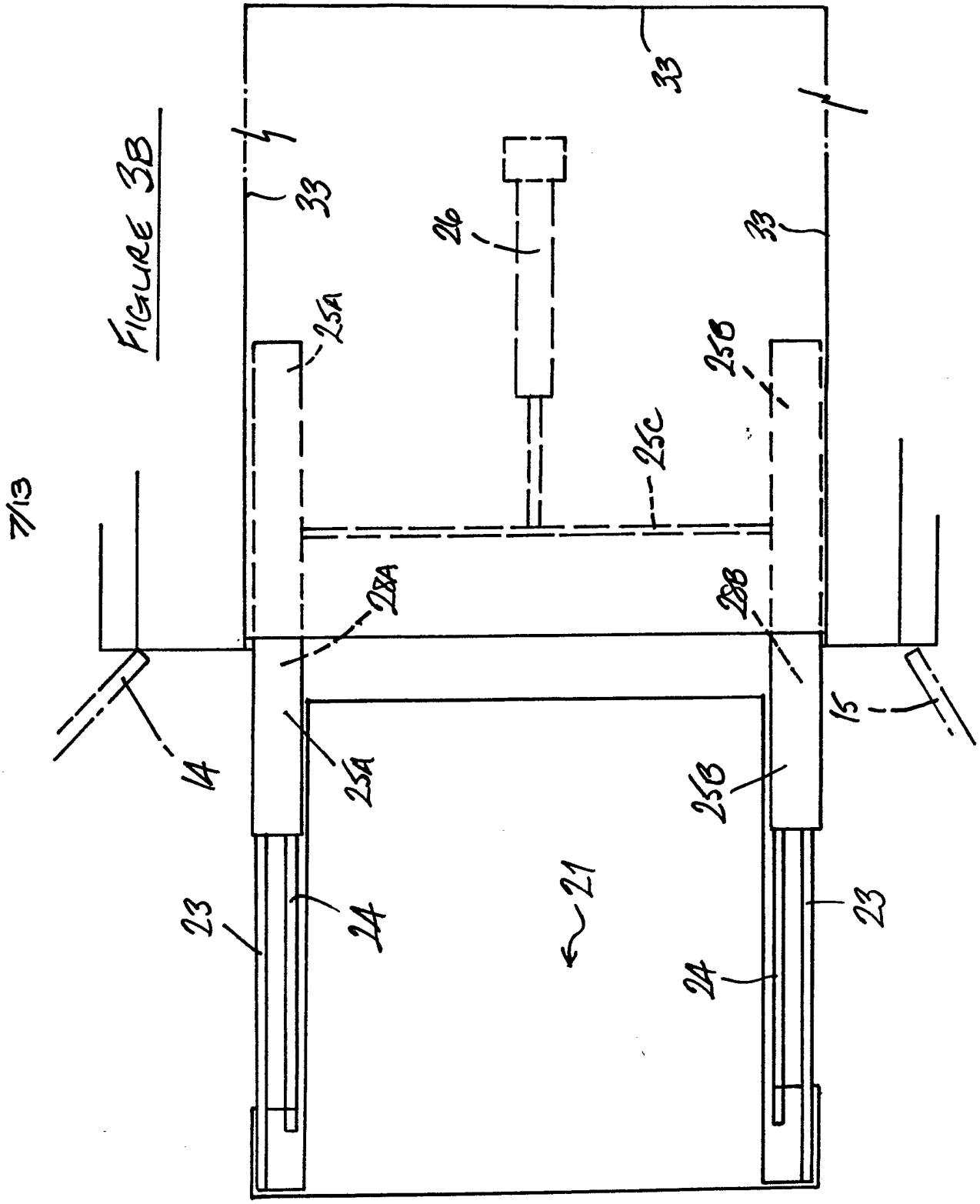


FIGURE 3B



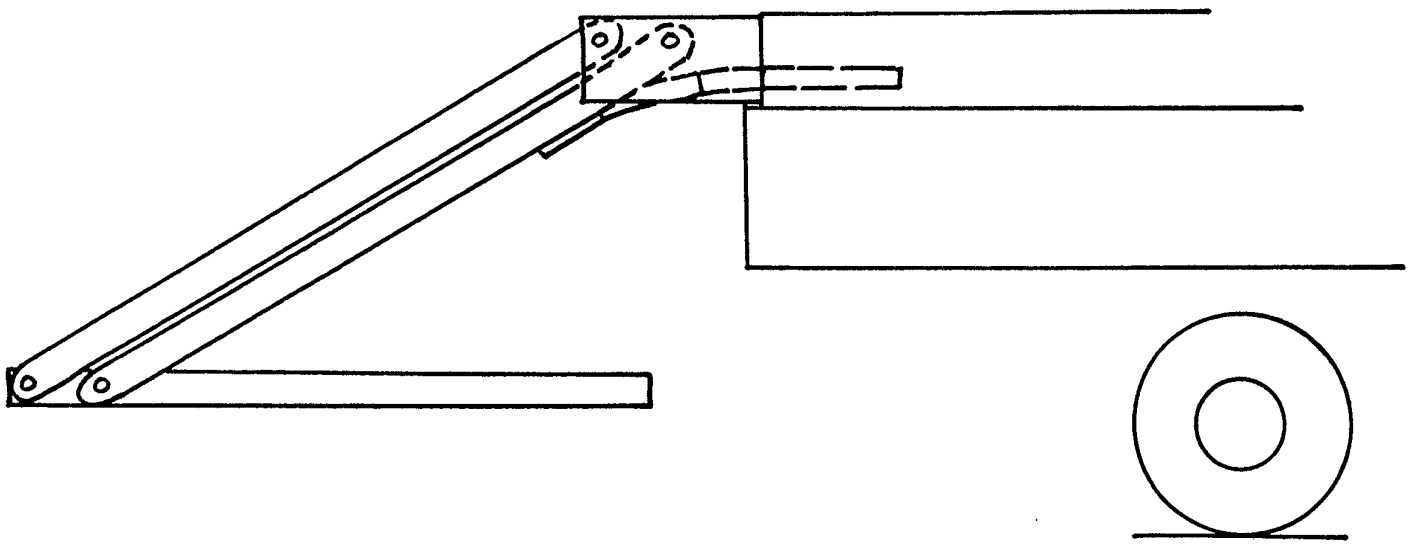


FIGURE 3C

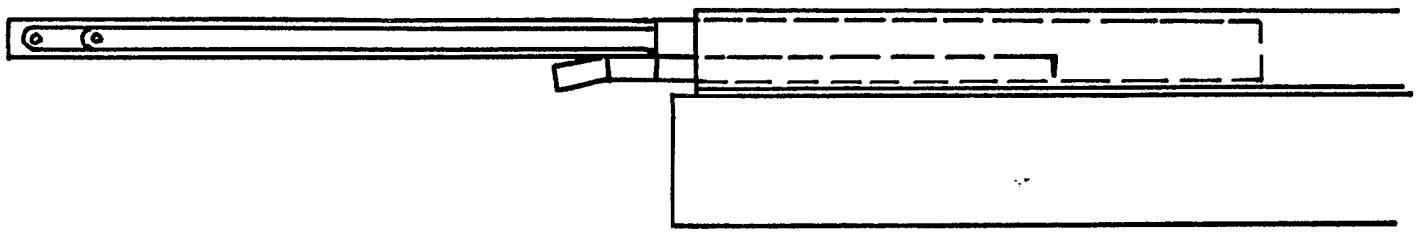


FIGURE 3D

FIGURE 4A

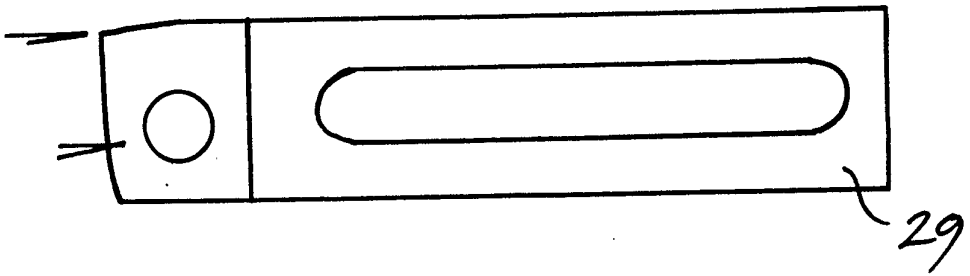
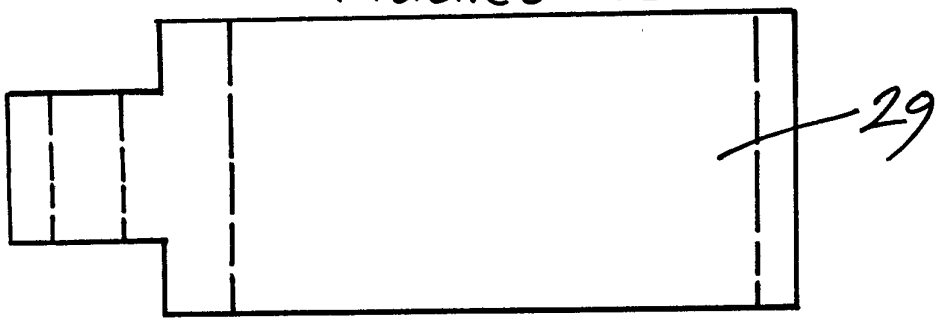


FIGURE 4B



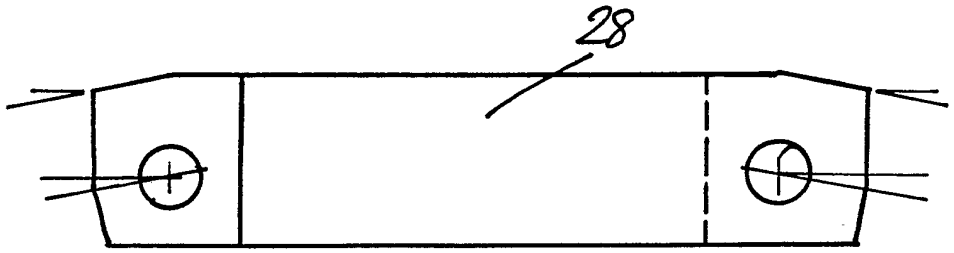


FIGURE 4C

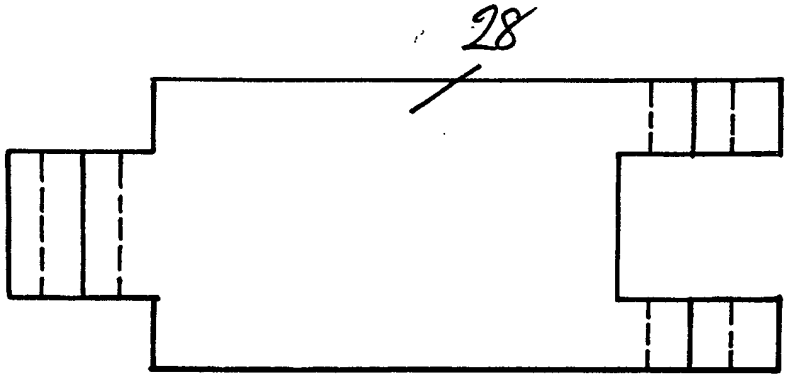


FIGURE 4D

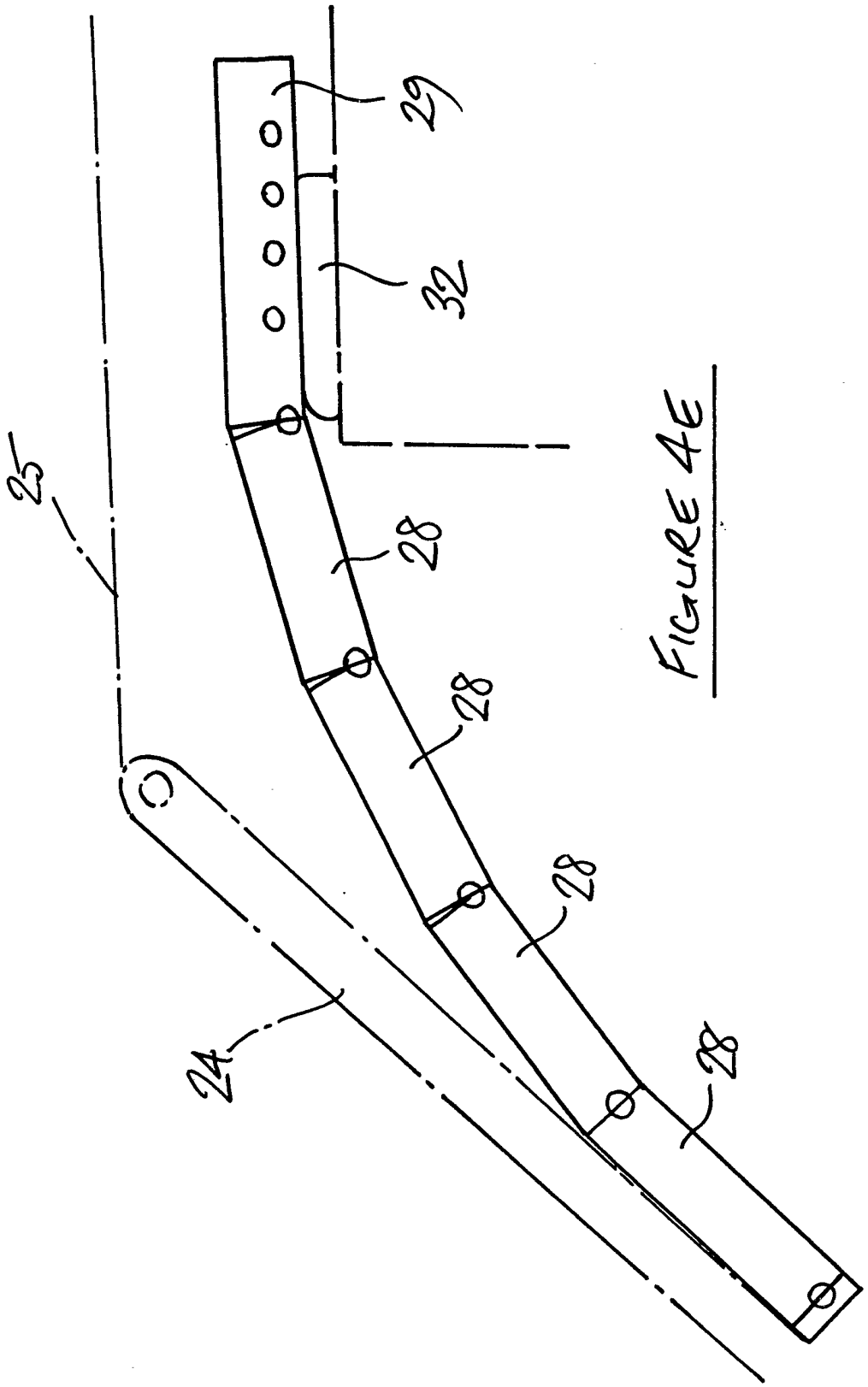
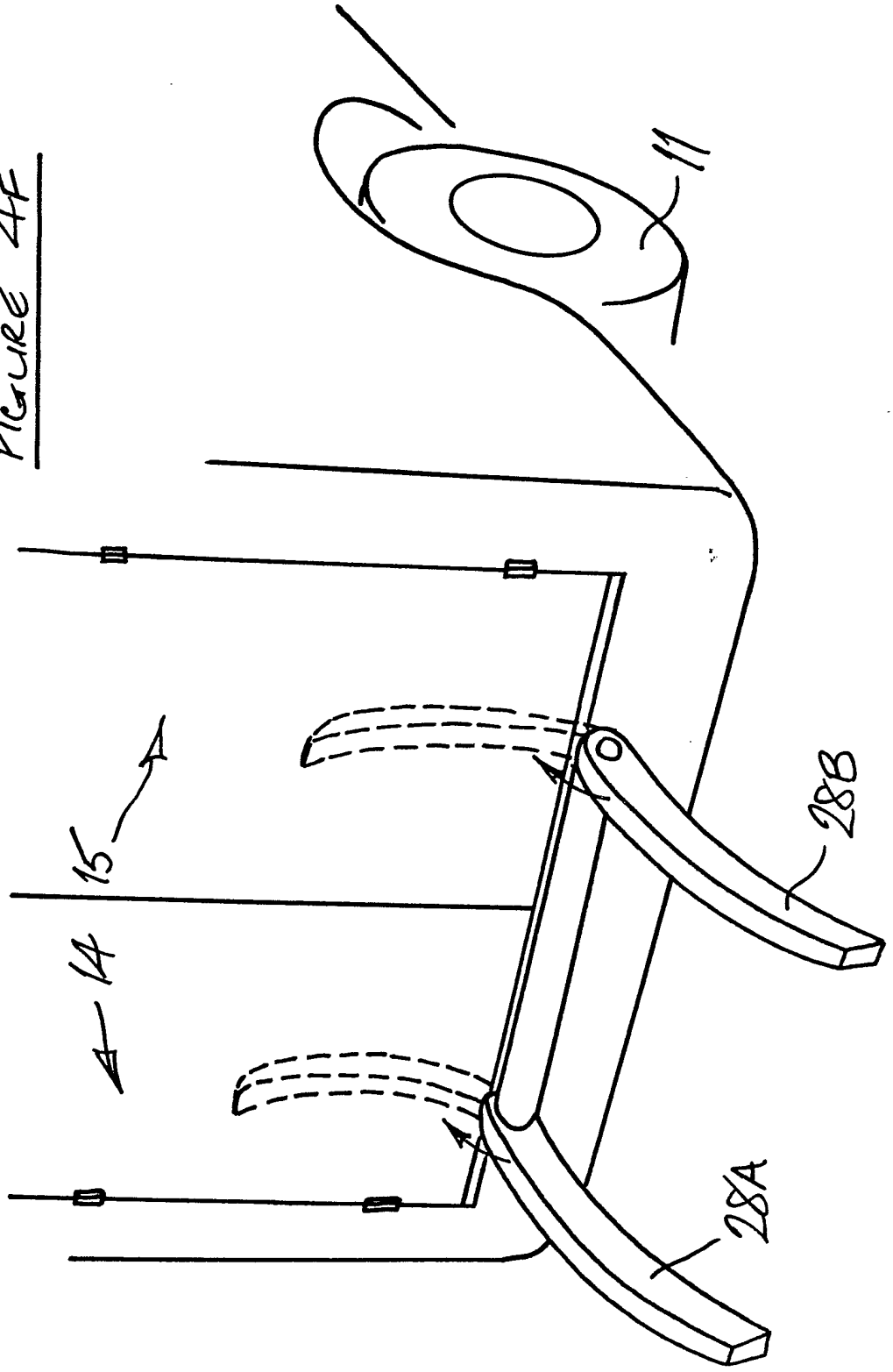


FIGURE 4E

FIGURE 4F



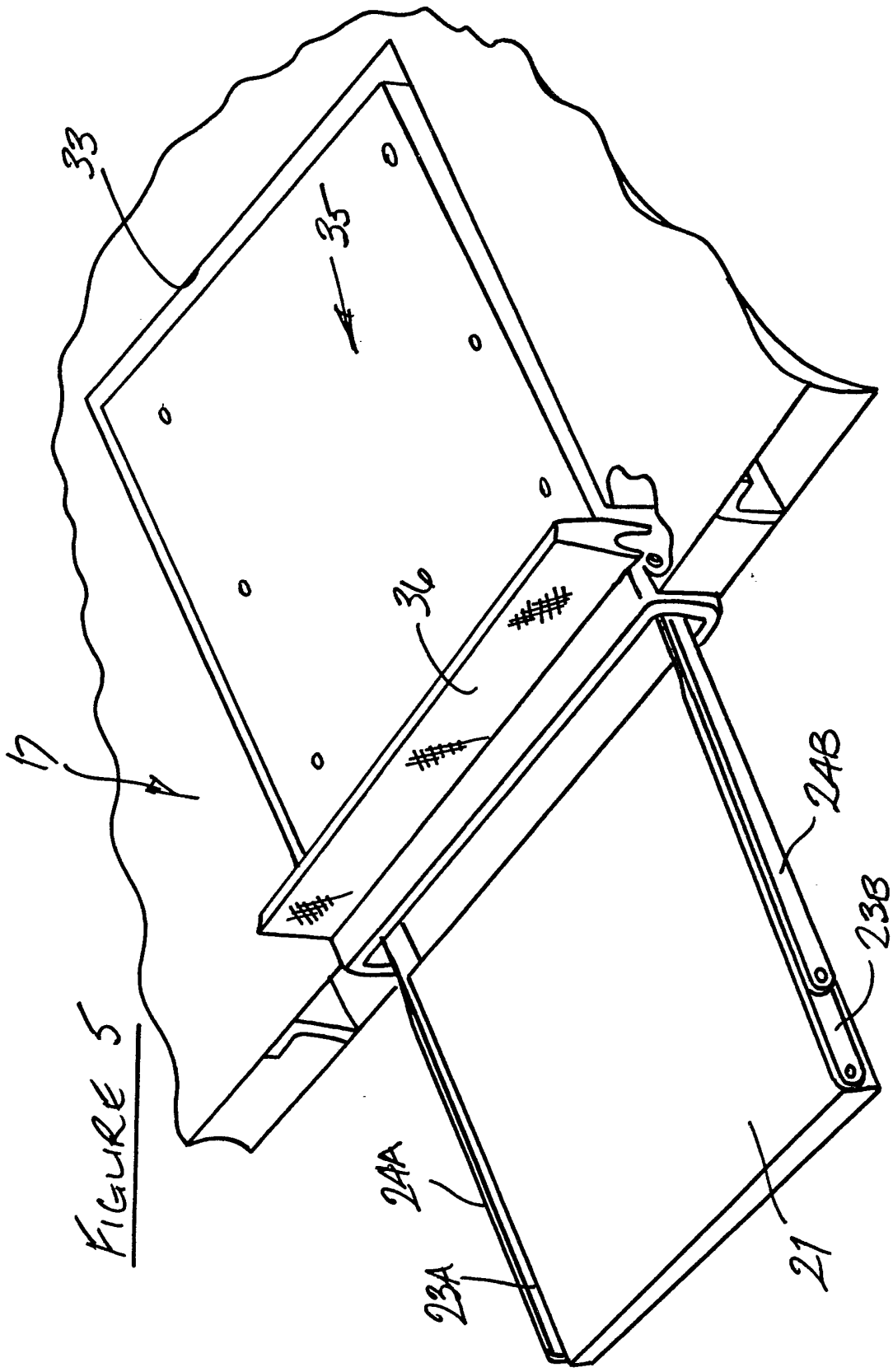


FIGURE 5

SPECIFICATION

Platform lift

The invention relates to platform lifts.

The invention is particularly, though not exclusively, applicable to platform lifts which can be mounted on a vehicle. Known forms of such lift can be mounted at the back of a vehicle, as illustrated in UK patent specifications Nos 1,131,564; 1,529,055; and 2,024,767A (Ratcliff). They are known as vehicle tail lifts. They consist essentially of two parallel spaced-apart upright guide members, fixed one on either side of the vehicle rear access opening and carrying the platform between them. Between the guide members is mounted a beam, housing the lift actuating mechanism: this normally consists of a hydraulic ram which raises and lowers the platform up and down the guide members via a system of pulleys and cables. In use, the platform stays substantially horizontal as it travels between the vehicle access opening and the ground on which the vehicle stands. When not in use, the platform is raised to the level of the vehicle access opening and is then swung up flat against the guide members and held there as the vehicle travels from one location to another.

These vehicle tail lifts are widely used. However they have several drawbacks. They are bulky and heavy, and so they put considerable strain on the back axle and suspension of the vehicle which carries them. For the same reason, they limit the payload which can safely be put onto the vehicle chassis, suspension and tyres. They are not suited to light delivery vans for these reasons, and also because they would make such vans unstable when unloaded. They are especially unsuited to small passenger-carrying coaches or other public service vehicles which demand a side-opening, not a rear-opening, access door and which would be completely unbalanced by a tail lift of the kind illustrated in these UK patent specifications.

Less bulky tail lifts have been developed to try to cater for the needs of light delivery vans. Examples are shown in UK patent specifications Nos. 1,220,757 and 1,475,324 again published in Ratcliff's name. These consist again of two parallel spaced-apart guides carrying the platform between them and fixed one on either side of the vehicle rear access opening, but they also incorporate a deformable parallellogram linkage which initially swings the platform out of the rear of the vehicle before load lifting and lowering begins. The platform is raised and lowered along the guides as in the basic unit above. When not in use, it is swung, by folding the linkage, back into the rear of the vehicle, and swung upwards to lie flat against the guides; and the rear doors of the vehicle can then be closed on it for vehicle travel.

This light form of tail lift is less heavy than the basic tail lifts first discussed, but for its size, and given the size of van it is intended to fit, it is still unacceptably heavy. Like the basic lift, it uses the ram-operated cable and pulley system which is by no means totally reliable and in which the stroke of the ram, and effective lift of the cables, is limited by the width of the van. Like the basic units, it also requires the vehicle to be especially adapted to take it. Worst of all, the platform, the linkages, and the guides take up a considerable amount of the vehicle loading space, because they have to be mounted well into the vehicle in order for the vehicle doors to close on them for vehicle travel.

This second form of tail lift is still not suitable for vehicles with side access to their load carrying areas. Other attempted ways of combining the deformable parallellogram linkage construction with a straight up-and-down platform movement have led to construction such as that shown in the Ratcliff UK patent specification No. 1,413,182 which is more bulky and heavy than ever and is totally unsuited to any form of light van or coach.

The Ratcliff UK patent specification No. 1,446,656 does show one form of platform lift developed specifically for use with a side-entry van. This uses a deformable parallelogram linkage to move the platform between the van loading area and the ground on which the van stands. When not in use, the lift as a whole is stowed underneath the van. This construction certainly achieves an improvement in so far as it is considerably lighter in weight than the previous Ratcliff constructions referred to above. However when stowed it is extremely vulnerable. It is also, still, a considerable weight relative to the weight of the vehicle, and it is stowed in a potentially dangerous lopsided position to one side of the centre line of the vehicle chassis: if the vehicle is not carefully loaded, to compensate for this, excessive strain is placed on the chassis, and the vehicle handling characteristics can be dangerously affected. The length of the platform itself is limited by the need to accommodate the platform within just under half the vehicle body width, and the construction has not found wide usage commercially.

In summary, all these prior Ratcliff lifts exhibit the same recurring drawbacks. They are relatively heavy for the size of vehicle they are intended to fit. When stowed, they affect the weight distribution of the vehicle, or they take up an undue amount of its loading space, or both. The size of platform, and lift stroke, is limited because of the positioning of the lifting mechanism and the way in which it operates. Finally all of them share the common feature that once the platform has reached the load-carrying floor of the vehicle it cannot then take the load forward into the vehicle: the load must positively be transferred from the platform into the vehicle before the platform can either be lowered again or stowed.

The invention seeks to provide a platform lift which is suitable for use with rear-loading or side-loading vehicles; which can travel with the vehicle without putting undue strain on the vehicle without taking up an inordinate amount of payload space; which will maximise the platform whilst allowing the platform to travel with its load into the load-carrying area of the vehicle; and which will generally be more reliable, more adaptable, and more versatile than the prior units discussed above.

In a platform lift embodying the invention in its broadest aspect, a load lifting and lowering platform

is pivotally suspended on the adjacent ends of the arms of a deformable parallellogram linkage; the other ends of the linkage arms are pivotted to a chassis which is or can be mounted to travel back and forth out of and into a load-carrying area, for example a vehicle body, serviced by the platform; such back and forth travelling movement of the chassis causes one of the arms of the linkage (or a part connected thereto) to engage a curved surface; and the arm (or said part) is forced to follow the curvature of that surface, thus automatically unfolding or folding the linkage and thereby lowering or raising the platform.

Such a construction lends itself ideally to an arrangement in which, with the parallellogram linkage folded, and the platform, the travelling chassis, and the linkage arms all occupying substantially the same plane (or at least lying closely adjacent one another), the platform can move into the load-carrying area to discharge its load; or to be stowed within the vehicle during vehicle travel; or even to be stowed within the vehicle with the load still carried by the platform. This last case is particularly advantageous when carrying such things as invalid wheelchairs and their occupants, since they can be lifted into the vehicle, carried to their destination, and lowered from the vehicle, all without having to move off the platform.

The curved surface may be a rigid surface, fixed to or forming an extension of the load-carrying area, and possibly retractable when the platform is not in use. It may alternatively however comprise a flexible bar which can deform into a rigid curve and which can be straightened in order to be more easily retracted. Such a flexible bar could travel back and forth with the travelling chassis, deforming into a rigid curve in order to unfold the parallellogram linkage as the chassis moves one way, and progressively straightening to fold the linkage as the chassis moves the opposite way. In the case just outlined, the end of the flexible bar not secured to the travelling chassis may be pivotally secured to said one of the linkage arms, but this is not essential.

Any or all of the platform lowering, lifting and stowing stages of movement may be power operated or hand operated, possibly with spring assistance especially for any hand operated stage. For example the parallellogram linkage may unfold against a spring action which subsequently assists in folding the linkage and thus raising the platform and its load. Means would preferably be provided to lock the linkage, against the spring action, in such a case when the platform was being loaded: such means, when unlocked, would allow the spring action to assist in swinging the platform and its load towards the load-carrying area.

The platform, or the lift as a unit, may be held in its stowed position by doors closing off the loading area. Alternative or additional retaining means may be provided, for example a safety catch which may allow the platform to be raised to the level of the load-carrying area but which must positively be released before the platform can travel into the load-carrying area. Whatever arrangement is adopted, if the platform, the travelling chassis, and the parallellogram linkage all fold into substantially the same plane, and preferably slide into a gap into the floor of the load-carrying area, the lift when stowed takes up hardly any of the payload space.

Where the lift is wholly or partly power operated, suitable power packs are already part of the common general knowledge in this field. The prior UK patent specifications referred to above, together with other UK patent specifications published in the name of John Ratcliff (Tail Lifts) Limited, or Ratcliff Tail Lifts Limited, give ample details of various power mechanisms, safety mechanisms, locking mechanisms and the like.

Several forms of platform lift each embodying the invention are shown in the accompanying drawings. They will now be described with reference to those drawings. They are only examples of forms which the invention might take within its broadest aspect.

In the drawings:

Figures 1a, 1b and *1c* show a first platform lift in respectively side elevation, plan and end elevation;

Figures 2a and *2b* show in side elevation and plan a variation on the lift of Figure 1;

Figures 3a, 3c and *3d* show in side elevation various stages in the lifting movement of another platform lift, shown in Figure 3b in plan;

Figures 4a to *4f*, drawn to an enlarged scale, show in detail some important parts of the lift illustrated; and

Figure 5 shows in perspective another lift embodying the invention.

The platform lift shown in Figures 1a to 1c is a power operated lift which is fitted, in use, to the rear of a light delivery van. Parts of the van are shown diagrammatically in the drawings, but it is not necessary to illustrate or describe it in any detail. The van rear wheels are referenced 11, the chassis 12, and the body 13. The van has double opening doors respectively 14, 15 which are shown only in Figure 1b. The original floor level of the van is indicated at 16, but a new, false floor has been built up to a level 17 to receive loads from the platform lift.

When the doors 14, 15 are opened, the body side frames 18, 19 define with the false floor 17 the extent of the rear access opening of the van body.

The platform of the lift is referenced 21. It is hinged approximately half way along its length, as indicated at 22, so that it can fold right over clockwise (when viewed as in Figure 1a) on top of itself for stowage within the vehicle. The platform is of substantial size, and would normally be braced and stiffened underneath and be of welded steel construction. It is not necessary to describe the construction in detail. The top surface of the platform, which presents a substantially flat and uninterrupted loading surface, may be treaded or given some other anti-slip treatment.

The platform 21 is suspended pivotally on the adjacent ends 23a, 24a of the arms 23, 24 of a deformable parallellogram linkage. The other ends 23b, 24b of the arms 23, 24 are pivotted to a chassis 25 which, with the arms 23, 24 and the platform 21, forms the parallellogram.

A fluid pressure operated ram 26 is mounted inside the van body 13 and runs alongside the

chassis 25 which is itself basically in the form of a stiff rectanglular framework. The rod end of the ram 26 is connected, as shown at 27, to that end of the chassis 25 remote from the double doors 14, 15 of the van body. The ram cylinder is fixed within the vehicle body, but when the rod of the ram extends it carries the chassis 25 with it on rollers, needle bearings, or another anti-friction travelling slides which need not be illustrated and are not referenced.

A flexible elongate bar 28 is pivotally secured at one end 29 to the travelling chassis 25 and at its other end 31 to one of the linkage arms 24. The construction of this bar 28 will be described in detail later on in this specification, but basically, with the parallellogram linkage unfolded as shown in Figure 1a, the bar 28 is deformed into a rigid curve, whilst when the ram 26 is actuated to draw the chassis 25 to the right (viewed as in Figure 1a) the sections of the flexible bar 28 are drawn successively over a wear pad 32 and into the vehicle and the bar 28 is progressively straightened.

As the ram 26 is extended, and the bar 28 progressively straightens over the wear pad 32, the arm 24 is forced to follow the curvature of the bar 28 and will thus be pivotted clockwise (viewed as in Figure 1a) about its pivot 24b. This will automatically fold the parallellogram linkage and swing the platform 21 from its position shown in Figure 1a to a new position in which, when the bar 28 is fully straightened with pivot 31 on the point of entering the van body, the load-bearing surface of the platform 21 is at substantially the same level as the level of the false floor 17 inside the van body; and the platform 21, the linkage arms 23, 24, and the travelling chassis 25 all lie in substantially the same plane. At that stage, the rear half of the platform 21 can be swung about the hinge 22 completely over on to the front half of the platform, the load first having been transferred from the platform on to the false floor 17. The lift unit, consisting of the platform, the linkage arms, and the travelling chassis, can then be slid forward on suitable bearings (not shown or referenced) into a gap 33 cut into the false floor 17. Slides 34 are provided to ease the passage of the platform into the vehicle body. When fully home, the platform fits neatly into the gap 33, although the rear half of the platform will of course project above the general level of the false floor 17.

The hinge 22, which is the rearmost part of the lift unit when the unit is stowed into the vehicle in the manner just described, is sufficiently far inside the vehicle for the double doors 14, 15 to be closed on it. The doors thus hold the unit as a whole in place inside the vehicle during vehicle travel.

There is only one parallellogram linkage and travelling chassis, mounted at one side of the platform, as Figures 1a to 1c clearly show. At least the arm 24 is therefore substantially braced and stiffened to resist twisting of the platform as the platform is raised and lowered. The final stowing sliding movement of platform, linkage arms, and travelling chassis as a single unit into the gap 33 in the false floor 17 may be accomplished by continued extension of the ram 26; or it may be a hand movement since the unit simply needs to be slid fully home before the double doors 14, 15 can be closed on it.

Figures 2a and 2b show a variation on the construction of Figures 1a to 1c. A single deformable parallellogram linkage is again used, but there are two fluid pressure operated rams 26a, 26b moving the travelling chassis 25 back and forth into and out of the vehicle. Also in this case the vehicle is not an enclosed van but is an open-topped truck. The platform 21 can fold, but for extra long loads the twin cylinders 26a, 26b can continue to extend along the floor of the open truck and carry the whole length of the platform 21 on to the truck body without the platform having to be folded and without an extra long load having to be taken off it. In this version also, the platform 21 occupies substantially the full width of the access opening to the truck body. By contrast, the platform of Figures 1a, 1b and 1c does not span the full width of the access openings 17, 18, 19.

Apart from these alterations the arrangement of Figures 2 is essentially the same as that of Figures 1, and parts of the two sets of figures which correspond to one another have been given the same reference numerals.

The lift shown in Figures 3a to 3d has many similarities to those illustrated and just described with reference to Figures 1 and Figures 2. Corresponding parts have again been given the same reference numerals. However this lift has its platform 21 suspended between two parallellogram linkages, one on either side of the platform. There are accordingly two travelling frames 25a, 25b joined by a crossbar 25c to form the travelling chassis 25. As previously, the chassis 25 travels on suitable bearings into the vehicle body, but the arm 24 of the parallellogram linkage need not be so rigid because there are two linkages to take the strain of the platform and its load.

In the Figure 3 embodiment, the deformable flexible bar 28 is again used and is secured at one end to the frames 25a, 25b. There are two bars 28, one for each frame of the travelling chassis 25. However the other ends of the bars 28 are not secured to the arms 24 of the parallellogram linkage. The undersides of the arms 24 bear against their respective curved bars 28, and are forced to follow the curvature of the bars 28 progressively straighten when the frames 25a, 25b are pulled into the vehicle by a single centrally mounted cylinder 26. However the movement between the arms 24 and bars 28 is a frictional sliding one: as the bars 28 straighten, they force the arms 24, and hence the entire parallellogram linkages, to fold upwards.

Figures 3a, 3c and 3d show the gradual progressive upward folding movement of the parallellogram linkages. As before, once the Figure 3d position is reached, the cylinder 26 can continue to extend to pull the platform lift unit fully into the vehicle; or the unit can be pushed home by hand since it needs only to slide horizontally along suitable bearings. It will be noted that the platform 21 extends, in this embodiment, no farther than the ends 23a, 24a of the linkage arms 23, 24. The whole lift unit can be pushed home from its Figure 3d position without the

load having first to be removed from the platform 21. The platform can subsequently be pulled out of the vehicle, and lowered back to its Figure 3a position, with the load still on it.

Figures 4a and 4b show the precise form of the inner endmost link 29 of the flexible bar 28. Figures 4c and 4d show similarly the form of the remaining links which go to form the flexible bar 28. There are five of these links in the or each bar 28, plus the top link 29, and they are all pin-jointed by suitably hardened steel pins which are not shown in detail. Figure 4e shows the bar 28 deformed into a rigid curve free-hanging from the back of the vehicle to which the lift is fitted (i.e. in position corresponding to Figures 1a, 2a and 3a). When the bar is pulled to the right of Figure 4e over the wear-pas 32, it will inevitably straighten and in doing so it will fold the parallellogram linkage or linkages upward and raise the platform from the ground to the level of the vehicle floor. Figure 4f shows solid bars 28 in use.

Finally Figure 5 shows in diagrammatic perspective another form of lift embodying the invention, this time entirely hand-operated. The platform 21 is suspended as in Figures 3 between two parallelogram linkages 23, 24, one on either side of the platform, and there are again two travelling frames 25a, 25b linked by a cross-beam 25c to form the travelling chassis 25.

Figure 5 shows the lift unit in position corresponding to that of Figure 3d, i.e. with the platform, linkage arms, and travelling chassis all occupying substantially the same plane and ready to be slid into the vehicle which carries the lift. When slid forward into the vehicle, the lift unit enters an open-ended box 35 in which it is eventually fully accommodated. The double doors, not shown in Figure 5, can then be closed on the unit. The box 35 fits into a gap 33 in the false floor 17 of the van and is securely screwed or bolted in place. The entire lift unit can thus be removed, by simply unscrewing the box 35 and taking the unit out of the vehicle. Spring assistance is provided to raise the platform 21 of Figure 5 into the position shown in Figure 5. The springs may take the form of torsion springs in the pivots of the parallellogram linkage. Alternatively the flexible bars 28 may be spring-loaded 'straight' and, if their outer ends 31 are positively secured to the arms 24 of the parallellogram linkages, will then resist unfolding of the linkages. Once the linkages are unfolded, for example by two men sitting on the platform to sink it to the ground, and the platform has been loaded, the spring action will assist in bringing it back to its Figure 5 position.

Sliding the platform and the rest of the lift unit home into the vehicle from the Figure 5 position need not be spring assisted, since only horizontal pushing movement is needed.

A locking plate 36 is shown in Figure 5. When the platform 21 of Figure 5 is on the ground, with its parallellogram linkages unfolded, the plate 36 can be swung down and the front edge of the plate engages a notch (not shown) in each of the upper surfaces of the front arms 23 of the parallellogram linkages to hold the linkages open against the spring action. When the platform is ready to be lifted, the plate 36 is released from the notches but it is not yet returned to its Figure 5 position. Instead it rides along the tops of the arms 23 as the platform 21 comes up. When the platform 21 reaches its Figure 5 position, the plate 36 rests substantially horizontally across the tops of the arms 23 and closes the gap between the platform and the box 35 to allow loads to be transferred from the platform into the vehicle. Finally the plate 36 is swung to its Figure 5 position to allow the platform, the parallellogram linkages, and the travelling chassis to be slid fully home into the box 35.

Once this has been done, the plate 36 can be swung anticlockwise (viewed as in Figure 5) through 180°C from its Figure 5 position to seal off the open end of the box 35 and keep the lift unit stowed inside it. Double doors, not shown, can close on the plate 36 when it is in this position.

In any of the arrangements illustrated, the flexible bar 28 could be spring-loaded 'straight' to assist the upward folding of the parallellogram linkages in the manner just described with reference to Figure 5, for example by torsion springs in its pivots. In the power operated hand stowed lifts described and illustrated, if the ram 26 fails, the lift can still be manually slid home and the vehicle driven back for repair to the power pack. This may be achieved simply by uncoupling the rod of the ram 26 from the travelling chassis 25. It is made easier if spring assistance is provided to fold the linkages as has just been described.

Instead of the platform rear part of Figures 1a to 1c folding completely over on top of the platform front part, it could fold through only 90 degrees from its illustrated position to stow vertically during vehicle travel.

Other forms of spring loading may be used in the wholly or partly hand-operated versions of the lift. For example, coiled tension springs could extend along the chassis longitudinally in place of the illustrated hydraulic rams, the springs opening against their tensioned action as the lift slides into its operating position and opening still farther as the linkage unfolds to lower the platform to the ground.

CLAIMS (Filed 8 June 1982)

1. A platform lift in which a load lifting and lowering platform is pivotally suspended on the adjacent ends of the arms of a deformable parallellogram linkage; the other ends of the linkage arms are pivotted to a chassis which is or can be mounted to travel back and forth out of and into a load-carrying area, for example a vehicle body, serviced by the platform; such back and forth travelling movement of the chassis causes one of the arms of the linkage (or a part connected thereto) to engage a curved surface; and the arm (or said part) is forced to allow the curvature of that surface, thus automatically unfolding or folding the linkage and thereby lowering or raising the platform.

2. A platform lift according to Claim 1 and in which, with the parallellogram linkage folded, the platform and the travelling chassis and the linkage arms all occupy substantially the same plane (or at

least lie closely adjacent one another) and the platform can be moved into the load-carrying area with the chassis and linkage.

3. A platform lift according to Claim 1 or Claim 2 in which the load-carrying part of the platform remains substantially level as it travels back and forth out of and into the load-carrying area.

4. A platform lift according to any of the preceding Claims and in which the curved surface is a rigid surface which is fixed to or which forms an extension of the load-carrying area and which is retractable when the platform is not in use.

5. A platform lift according to any of Claims 1 to 3 and in which the curved surface comprises a flexible bar which can deform into a rigid curve and which, in use, travels back and forth with the travelling chassis, the bar deforming into a rigid curve in order to unfold the parallellogram linkage as the chassis moves one way, and positively straightening again to fold the linkage as the chassis moves the other way.

6. A platform lift according to Claim 5 and in which the end of the flexible bar not secured to the travelling chassis is pivotally secured to said one of the linkage arms.

7. A platform lift according to any of the preceding Claims and in which the platform, the travelling chassis, and the parallellogram linkage all fold into substantially the same plane and can slide forward into a gap in the floor of the load-carrying area.

8. A platform lift according to any of the preceding Claims and in which the platform, the chassis and linkage when folded slide forward into a box which is fitted in the load-carrying area and which forms with the platform, linkage and chassis a self-contained removable unit.

9. A platform lift substantially as described herein with reference to and as illustrated in Figures 1A, 1B and 1C and Figures 4A to 4E of the accompanying drawings.

10. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figures 2A and 2B of the accompanying drawings.

11. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figures 3A to 3D of the accompanying drawings.

12. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figure 4F of the accompanying drawings.

13. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figure 5 of the accompanying drawings.

14. A vehicle fitted with a platform lift in accordance with any of the preceding Claims.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1983.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

PUB-NO: GB002107671A

DOCUMENT-IDENTIFIER: GB 2107671 A

Platform lift

PUBN-DATE: May 5, 1983

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APPL-NO: GB08117413

APPL-DATE: June 8, 1981

PRIORITY-DATA: GB08117413A (June 8, 1981)

INT-CL (IPC): B60P001/44

EUR-CL (EPC): B60P001/44

US-CL-CURRENT: 414/558

ABSTRACT:

A load lifting and lowering platform 21 is pivotally suspended on the adjacent ends of the arms 23, 24, of a deformable parallelogram

linkage. The other ends of the linkage arms are pivotted to a travelling chassis which, in use, moves back and forth out of and into a vehicle body serviced by the platform. One of the arms of the linkage engages a curved surface 28, and is forced to follow the curvature of that surface to automatically unfold or fold the linkage and thereby lower or raise the platform. The curved surface may be a rigid surface which can be swung up out of the way when the platform is stowed, or it may be a flexible bar as shown which can deform into a rigid curve to unfold the linkage and then progressively straighten again to fold the linkage.

Preferably the deformable bar travels with the chassis into and out of the vehicle body, and in one particular embodiment the platform, bar, linkage and travelling chassis all slide forward into a box which is fitted into the vehicle floor and is removable as a self- contained lifting unit. □